

Running head: REVENUE AND FIRE-BASED EMS

The Revenue/Response Dilemma: Patient Transport Services in a Fire-Based EMS Environment

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CERTIFICATION STATEMENT

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### Abstract

This research attempted to determine feasibility of continuing fire-based ambulance services within the City of El Paso, Texas. The specific problem identified was the El Paso Fire Department had not studied the continued feasibility of providing ambulance transport services within the El Paso community since its merger with the former Department of EMS. The purpose of this evaluative research was to appraise the sustainability of the current service model for the city of El Paso and attempted to answer the following questions: (a) what are the present costs to the department for providing patient transport services; (b) what is El Paso's price-subsidy tradeoff; (c) to recover system costs and given the existing payer mix, what base fee should the EPFD charge to users of the emergency medical system; and (d) what operational impact would discontinuing transport service have on current service level objectives for fire/EMS calls? System costs were analyzed from the most recent budget report to separate the patient transport system costs from the rest of the fire department's services. Response data from the most recent 12-month period was analyzed to determine the price-subsidy tradeoff as well as establish baselines for the studying the impact of system changes. Deccan ADAM™ was used to determine travel time impacts for eliminating ambulances and adding personnel to existing fire companies. Total fixed system costs amounted to \$16.98 million, the price-subsidy tradeoff was approximately \$9.50 and system travel times degraded for all scenarios when ambulances were removed. The department should explore creative ways to reduce cost without affecting travel times and attempt to determine the value of providing BLS service so an appropriate fee could be charged a potential provider of private ambulance service.

## Table of Contents

1. Introduction	7
2. Background and Significance	9
3. Literature Review	18
4. Procedures	28
5. Results	31
6. Discussion	37
7. Recommendations	42
8. References	45
9. Appendix A: Transport Fee Comparisons	50
10. Appendix B: Staffing Factor Worksheet	51
11. Appendix C: Marginal Personnel Requirement Calculations	52
12. Appendix D: Additional System Measures	53

**List of Tables**

Table 1 ..... 15  
Table 2 ..... 24  
Table 3 ..... 31  
Table 4 ..... 32  
Table 5 ..... 34  
Table 6 ..... 35  
Table 7 ..... 36

**Table of Figures**

Figure 1	13
Figure 2	14
Figure 3	17
Figure 4	33

## Introduction

As emergency medical systems have evolved in the United States, the public has been made increasingly aware of the benefit of rapid intervention and rapid transport during life-threatening emergencies. Time is a critical component in the evaluation of success for emergency response. For instance, the concept of the “golden hour”, in use since at least the 1970s, suggests that trauma patients have only 60 minutes to receive lifesaving medical treatment or risk irreversible tissue damage (Lerner & Moscati, 2001). Likewise, the Chain of Survival, a time-based illustration of the links in the emergency medical chain that contribute to positive cardiac outcomes, is cited by industry experts as an important consideration for emergency medical system design (Travers, et al., 2010).

Nevertheless, despite more than 50 years of the presence of emergency medical systems (EMS) around the United States and much operational research, consensus regarding system success has been doggedly elusive. Attempts are underway to define and standardize performance measures as well as encourage paying providers based on patient outcomes, but response time continues to be the most cited system parameter (National Association of State EMS Officials; National Association of EMS Physicians, 2009; Henderson, 2009). Faster response times are generally accepted as proof of system success and many providers, public and private, deploy resources to minimize basic and advanced life support (ALS and BLS) response times. Naturally, response time is not the only measure of system success; EMS managers must also ensure sustainability through efficient resource deployment and sufficient revenue. The city of

El Paso has consistently used response time to measure success and deploy resources from the start of its emergency medical service.

As a provider of emergency medical transport services, the El Paso Fire Department (EPFD) bills patients for services and has used a third party biller to do so for many years. Revenues, however, have never been directly associated with system expenses since they are normally reckoned with total city revenue and become part of the general fund. In 2010, revenues began a decline in part due to the nation's economic downturn and the resulting increased rate of uninsured requesting ambulance transport in El Paso. Concurrently, around the United States in larger markets, well-funded private ambulance providers began making a concerted push to capture additional revenue. Though El Paso has not been approached as other cities have been because it has not experienced the same fiscal problems, the feasibility of providing transport services as well as the prudence of ensuring the most efficient use of taxpayer resources necessitates at least a periodic review of this government-provided service. Moreover, with the American population aging, hospital emergency room visits as well as use of associated ambulance transport services is expected to increase dramatically in the coming decade. This increasing demand coupled with decreasing Medicare and Medicaid reimbursement for services is likely to put extreme pressure on EMS providers such as the EPFD to maintain acceptable service levels and ensure long-term financial sustainability.

The problem is the EPFD has not studied the continued feasibility of providing ambulance transport services within the El Paso community. The purpose of this research is to evaluate the feasibility of providing ambulance transport services for the city of El Paso and

attempts to answer the following questions: (a) what are the present costs to the department for providing patient transport services; (b) what is El Paso's price-subsidy tradeoff; (c) to recover system costs and given the existing payer mix, what base fee should the EPFD charge to users of the emergency medical system; and (d) what operational impact would discontinuing transport service have on current service level objectives for fire/EMS calls?

### **Background and Significance**

Since the late 1970s, the city of El Paso has provided emergency medical transport services for Emergency Medical Services System (EMSS) users. For about 30 years, patient transport and advanced life support care were provided by the Department of EMS, a unit of the city that was separately managed by a chief of EMS and functioned under the direction of the city/county health authority (Ward, 1984). However in 2001, the department was merged with the fire department and the new department began operations as a fire-based EMS service.

Currently, the EPFD provides all-hazards emergency response for a population of about 650,000 in an area of approximately 260 square miles, most of which reside within the incorporated limits of the city of El Paso. In 2012, the department set its service level objectives for all emergency response types and codified these in a standards of cover document. Benchmark service level objectives germane to this research are as follows:

- For all fire responses in metropolitan or urban areas, the first arriving unit of the initial alarm with at least 3 firefighters shall arrive within 6 minutes

- and 20 seconds or less total response time 90 percent of the time and be able to establish initial fire ground operations;
- for all medium risk fire responses in metropolitan or urban areas, an effective response force of 19 total firefighters on scene with a minimum 2 – 1500 GPM pumpers and 1 aerial, all with full complement of equipment, shall assemble within 10 minutes and 20 seconds or less total response time 90 percent of the time;
  - for all emergency medical responses in metropolitan or urban areas, the first unit with at least 2 firefighters and BLS capability and equipment shall arrive within 6 minutes or less total response time 90 percent of the time; and
  - for all medium risk emergency medical responses in metropolitan or urban areas, an effective response force of a minimum 1 ALS capable unit on scene shall arrive within 10 minutes or less total response time 90 percent of the time (El Paso Fire Department, 2012, pp. 52-54).

To achieve its service level objectives, the department employs approximately 900 firefighters, who operate from 35 stations on 31 engines, 8 quints, 5 ladders, 6 battalion chief units, 1 squad, 1 specialized hazmat unit and 23 ambulances. Four peak-time ambulances are deployed 11 A.M. to 7 P.M. each day to handle ALS calls and transports as needed. All firefighters are cross-trained to at least the Emergency Medical Technician – Basic level and respond to the closest medical emergency when requested by the system. Though the department has begun a comprehensive campaign to train and equip all department units to

the ALS level, presently only the ambulances and about 8 fire units (when staffed with certified personnel) are considered ALS responders. And since all responders are firefighters as well as emergency medical technicians, ambulances are part of the department's initial alarm response to fires and other high-risk emergencies. All responding firefighters, whether they respond on an ambulance or fire unit, are considered in response time analyses for multi-company incidents.

To maximize the use of existing resources, the department uses a priority dispatching call triage protocol that attempts to match equipment and personnel more directly with the nature of the EMS call. Consequently, only one unit will be dispatched to a call depending on the seriousness of the patient's expected condition. An ambulance will be requested if a responding fire unit deems transport necessary or the patient requests it. This allows the department to better utilize its fleet of ambulances rather than automatically send two units to every medical call. However, for multi-company calls such as fires, the department tracks both the first unit's on-scene time as well as the arrival time of the second unit. The second time is known as the initial attack force (IAF) time. This is done because the department's maximum staffing on any one unit is 3 firefighters. Therefore, to comply with two-in, two-out requirements for firefighting, the department needs a minimum of two apparatus on scene.

### **The Local Revenue Model**

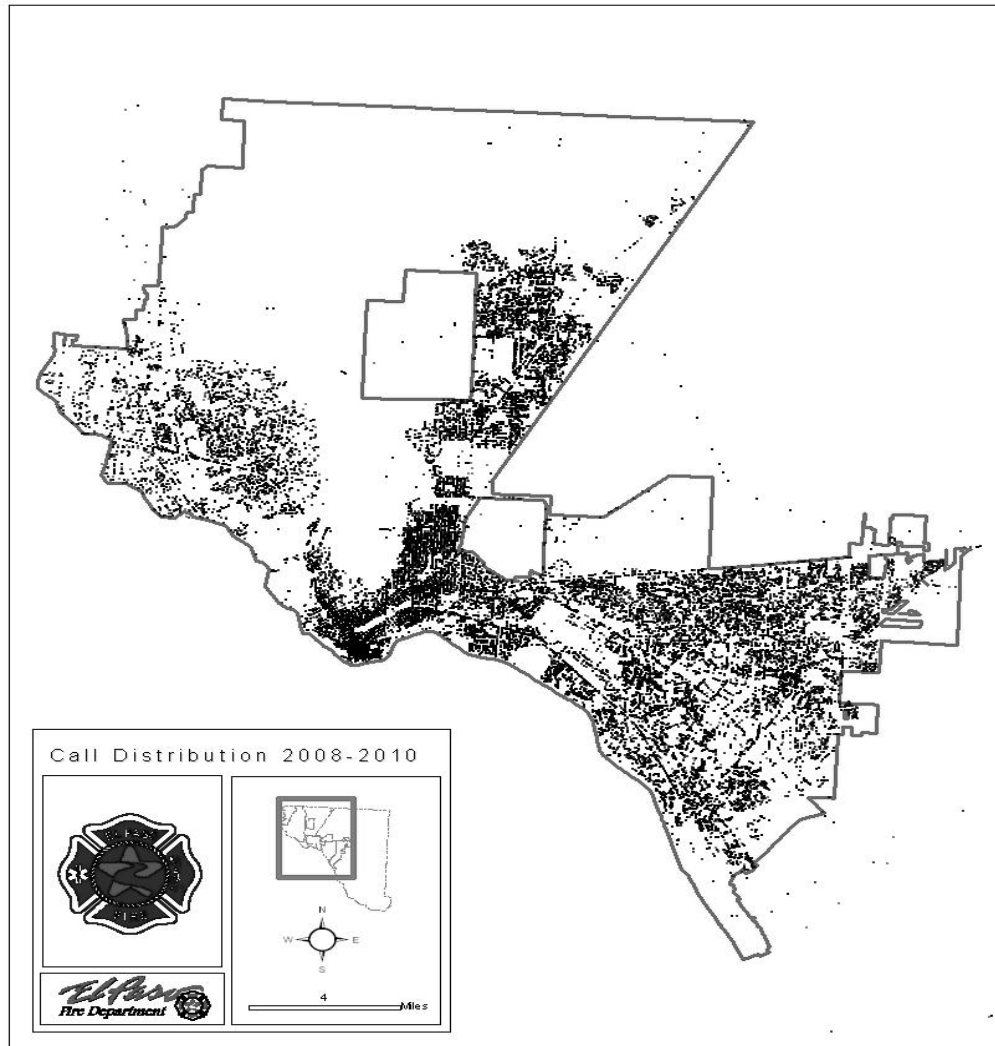
As the primary local transporter of emergency medical patients, the EPFD charges patients a base fee of \$775.00 with an add-on mileage charge of \$15.00 per mile to the nearest hospital emergency room. The base fee and mileage charges are in line with other Texas cities

of comparable size and are set only with the approval of city council. Table A-1 compares 2011 charges assessed by emergency medical service providers in other markets in Texas. Presently, transport fees are not charged based on true costs, but rather based on comparisons with other providers.

The city also charges a franchise fee to private ambulance services, who at times augment the fire department's response. These third party services provide less critical patient transport services and provide transfer services that do not qualify as true emergencies. The fee collected from these providers is not necessarily based on provider costs or city expenses. In Fiscal Years 2011 and 2012, the city received \$222,338.48 and \$255,561.99, respectively, from local ambulance providers.

### **Current Response Profile**

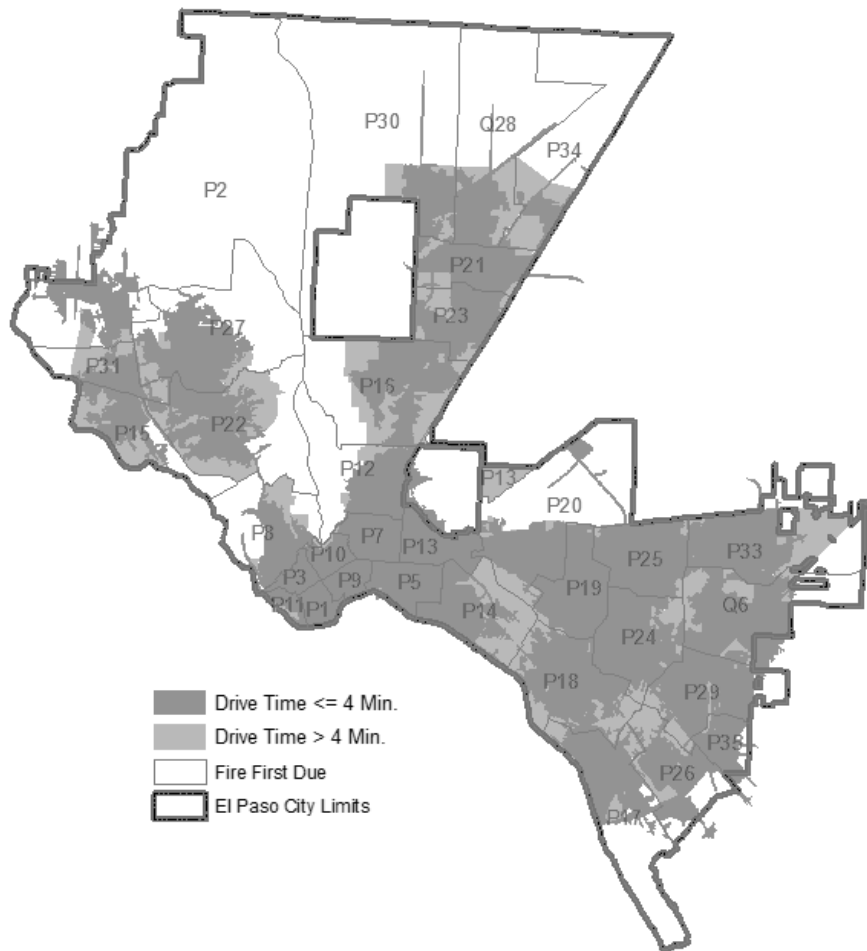
The department uses a combination of GIS-based drive time analyses, estimated demand, and service level response time requirements to deploy units in existing stations and prepare for future stations. Figure 1 plots current demand for all incidents the department responds to. Darker areas reflect a higher concentration of demand for all call types.



*Figure 1.* Demand distribution for all fire department service calls. Markers outside of city limits represent calls within the extraterritorial jurisdiction and/or on freeways.

Figure 2 depicts the most recent 4-minute drive time analysis from existing fire stations. Significant areas in the northern portions of El Paso show drive times longer than 4 minutes. Though not shown in the figure, most of these areas are 4-6 minutes in drive time from the nearest station, so travel times are still acceptable in these neighborhoods. Additionally, each

unit depicted in the figure is essentially representative of the station from which it responds even though more than one unit may respond from the same station.



*Figure 2.* Drive time zones around existing stations. Most areas in white are within 4-6 minutes of the nearest station. Unit symbols indicate the primary pumper company assigned to that station.

The EPFD’s emergency medical system revenue statistics are displayed in Table 1.

Franchise fees collected from local private ambulance services have been included as part of the system’s total revenue picture. In 2011, the department transitioned to a new third party

biller and experienced billing problems which led to decreased revenues. Consequently, despite a fairly constant transport volume and even a reduction in billing expenses, collections dropped substantially. The payer mix also changed with more uninsured users of the system compared to what was reported in previous years. The present payer mix is as follows: Medicare/Medicaid – 50 percent; commercial insurance – 16 percent; and self-pay (uninsured) – 34 percent.

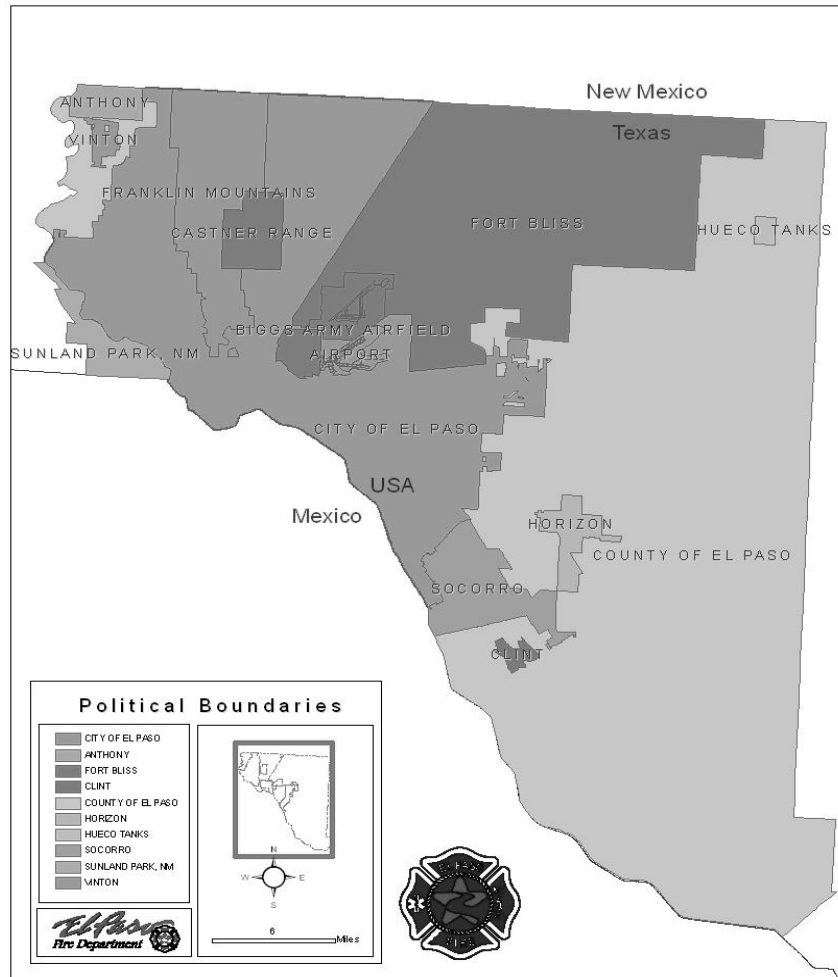
Table 1

*Pre-hospital EMS Revenue for the El Paso Fire Department*

<b>Year</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>
<b>Projected Revenue</b>	\$9,450,000.00	\$12,349,787.00	\$11,762,044.00
<b>Actual Revenue</b>	\$9,919,240.00	\$7,342,475.00	\$9,361,615.00
<b>Franchise Fees</b>	\$170,110.00	\$222,338.48	\$335,927.00
<b>Department Total Operating Budget</b>	\$76,538,576.00	\$85,039,638.00	\$88,134,043.00
<b>Transport Volume*</b>	46,038	35,192	36,915
<b>Total Ambulance Dispatches</b>	46,040	42,734	44,918

\* Total ambulance dispatches and transport volume figures taken from internal department response records

El Paso's unique location on the border with Mexico to the south, New Mexico to the north and Ft. Bliss to the east and northeast presents some unique challenges for emergency response coverage (see Figure 3). As can be seen in Figure 3, the city's footprint is much like an "L" with the added problem of a mountain range that almost splits the city in half between east and west. This complicates response time analyses since response units do not typically travel across the mountain range to emergencies on the other side. Therefore, the department analyzes and deploys resources based on demand in geographic zones and Graphical Information Systems (GIS)-derived drive times rather than based just on linear proximity. Additionally, analyses use the fixed posting locations of all fire units rather than attempt to account for dynamic vehicle movement.



*Figure 3.* El Paso’s political boundary is L-shaped with the Franklin Mountain range splitting it almost in half. Fort Bliss and Biggs Army Air Field form the northeastern boundary of the city. Much of the eastern portion of the county is undeveloped and unincorporated.

### Literature Review

As part of the larger debate regarding healthcare; costs and system funding are frequently encountered subjects in the literature. Regardless of where one sides in the debate of the public versus private provision of ambulance services, determining system cost is an important component in establishing profitability or sustainability. Costs are either fixed or variable. Factored into the simple revenue minus expenses equation, one should be able to use system costs to determine the firm's expected profits (Render, Stair Jr., & Hanna, 2004).

In order to more appropriately compare choices for service delivery among public and private providers as well as judge performance and potential sustainability, attempts have been made to establish consensus standards for system cost (Lerner, et al., 2012). Though debate may rage in some circles as to what elements and agencies truly make up the emergency medical services "system", system costs have been more narrowly defined herein as the components of pre-hospital emergency treatment, exclusive of hospital care and preventive education.

Nevertheless, tracking the true cost of an emergency medical service for comparative purposes has not been an easy undertaking. Few states today report success in determining the average cost of a 911-based EMS ground transport (Federal Interagency Committee for Emergency Medical Services, 2011). A recent team of industry experts developed a list of performance measures that originally included a "per capita agency operating expense," but elected to park the measure because of difficulty measuring and the lack of available research (National Association of State EMS Officials; National Association of EMS Physicians, 2009, p.

23). Consensus documents, however, agree on a number of cost categories, both direct and indirect, that should be included in cost analysis. These include:

- Labor costs – both direct and indirect or operations and support personnel;
- Vehicles and fleet maintenance costs – including costs of acquisition, operation and maintenance;
- Training;
- Emergency medical equipment and supplies;
- Facilities – including acquisition and maintenance costs;
- Communications – including the communications center, associated equipment and software;
- Liability insurance;
- Medical director oversight; and
- Administrative expenses – including billing and legal fees as well as general office expenses (Lerner, Nichol, Spaite, Garrison, & Maio, 2007; American Ambulance Association, 2008; Evans & Dyar, 2010; International Association of Firefighters, 2009).

Indirect expense calculations, though admittedly part of the aforementioned list, are at the heart of the debate over true system cost. Different positions have been taken with regard to what are true indirect system costs, particularly human resources. The International Association of Firefighters (IAFF) argues that firefighting resources used for both fire and EMS purposes should be excluded from cost calculations since they would be provided regardless of

demand (International Association of Firefighters, 2009). Other experts argue that cross-trained firefighters and equipment used in EMS response should be included as part of overall pre-hospital emergency care costs (American Ambulance Association, 2008; Evans & Dyar, 2010; Lerner, Nichol, Spaite, Garrison, & Maio, 2007; Fitch & Griffiths, 2005).

The debate regarding what to include in system cost is hardly a triviality. The importance of including all appropriate costs has implications for evaluating system performance, comparing providers, and even choosing system design. Indeed, without a true understanding of system cost, it is extremely difficult to evaluate an ambulance service, public or private (Brown & Potoski, 2005; United States Government Accountability Office, 2012). Likewise, poor cost figures can mislead policy makers into making decisions that ultimately cost taxpayers and system users more than anticipated.

### **The Public vs. Private Debate and Marginal Costing**

One of the most important calculations an EMS manager is encouraged to perform involves the concept of marginal cost. In the case of ambulance service, marginal cost is defined as the cost of producing one additional ambulance transport (American Ambulance Association, 2008, p. 79). Consequently, all appropriate costs must be identified and calculated to make additional production decisions. In this case, additional production could involve deploying more ambulances or making existing ones available for more hours.

Taken from economics, the concept of marginal cost implies that firms supplying ambulance services would attempt to do what all firms do, maximize profit. It is generally accepted that monopolistic firms (just like their competitive counterparts) would attempt to

produce at a point on the demand curve where marginal revenue equals marginal cost (Thomas & Maurice, 2008; Steinemann, Apgar, & James, 2005). For an ambulance service provider, marginal revenue would simply be the revenue associated with providing one additional ambulance transport.

Considering the implications of setting marginal revenue equal to marginal cost for pricing purposes, one could assume that patient transport pricing could be fixed per transport once the appropriate costs are identified. However, the ambulance service industry does not operate on traditional monopolistic terms.

One important difference from a monopoly in this case is that payers and consumers of the service are often two different entities. Put simply, users of ambulance services do not typically pay for it out of their own pockets. Therefore, the demand curve is almost completely independent of the underlying price. As such, it is assumed to be very inelastic - meaning demand is relatively the same regardless of price. Complicating this market reality is the fact that ambulance providers derive most of their revenue from a pool of no more than four main sources: Medicare/Medicaid, private insurance, individual payers, and local government subsidies. And because Medicare/Medicaid fix the prices they will pay for services, ambulance providers have little pricing power in the marketplace; this situation favors the public good argument and hinders the potential performance of private contractors (Overton, 2001). This has been one reason many feel that ambulance services should be left to the public sector. Indeed, in its most recent report, the U.S. Government Accountability Office (2012) suggests

that similar to hospitals that receive more federal funding, ambulance services that receive more Medicare/Medicaid payments have corresponding higher costs (p. 25).

Moreover, not only is price disconnected from demand, total revenue is unlikely to improve in the short-term either. For one, changes in price disproportionately fall on only one segment of the payer mix - private insurance (Fitch & Griffiths, 2005). This shifting of costs to one user over another is clearly unsustainable in the long-run. An increasing amount of research proposes that all users be charged full cost to encourage more conservative use of limited resources (Blackstone, Buck, & Hakim, 2007).

In the interim, limited pricing power has strong implications for the sustainability of an ambulance provider's operations. In theory, ambulance firms who cannot control short and long-term fixed and variable costs will operate in a negative marginal revenue environment. They will be encouraged to shed costs such as reduce the number of ambulances until marginal revenue equals marginal cost. Likewise, if demand is less than the average variable cost at every output level, the ambulance provider will fold if it cannot obtain government subsidies (Thomas & Maurice, 2008, p. 464). Despite this apparently bleak situation, the ambulance industry is expected to generate approximately \$14.5 billion in sales in 2013 (C. Barnes & Co., 2012). And in at least smaller cities or metropolitan statistical areas with many political jurisdictions, David and Chiang (2006) prove private ambulance services can flourish by capitalizing on a larger potential population across those jurisdictions (p. 25).

Clearly, the pre-hospital emergency care market is a large one and is expected to increase in the coming years with America's aging population. Additionally, recent moves into

the space by private equity firms should provide all ambulance service providers ample notice that at least some market players believe there is still plenty of profit in the sector and laissez faire management is an invitation for takeover (American Ambulance Association, 2008; Evans B. , 2011; McCallion, 2011). The public provision of ambulance services should not be taken for granted as the delivery method of choice for all communities, even those with long histories of public EMS systems.

As the public versus private goods debate heats up, the pressure is on to standardize cost calculations and performance measurement across providers. In addition to marginal cost, researchers and practitioners borrow from the field of operations research to determine how efficiently in-service ambulances are used. Derived from queuing theory, the *unit-hour utilization* (U:UH) productivity ratio helps measure how productive existing ambulances are and how many are needed based on demand (American Ambulance Association, 2008; Evans & Dyar, 2010). The IAFF contends that U:UH is too narrowly focused on patient transport and recommends that a calculation termed the “in-service utilization ratio” be used instead, which accounts for all demands on a unit’s time not just the revenue producing ones (International Association of Firefighters, 2009). Table 2 compares the two formulas.

Table 2

*Unit-hour Utilization and In-service Utilization Ratios Compared*


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U:UH Ratio =	$\frac{\text{Total number of transports in budget cycle (day, week, or month)}}{\text{Total number of unit hours}}$
In Service Utilization Ratio =	$\frac{\text{Total number of responses in budget cycle (day, week, or month)}}{\text{Total number of unit hours}}$

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A couple of other measures designed to measure the productivity and efficiency of ambulance service are *cost per transport* and *cost per unit hour* (American Ambulance Association, 2008). Both measures are designed for comparability purposes with other systems and are intended to include all costs, direct and indirect, of managing the ambulance service. Dividing the cost per unit hour by the U:UH ratio will also yield the cost per transport.

### **Subsidy-Price Tradeoff and Fee Determination**

Another cost measure common to ambulance services involves the level of support provided by the local taxpayers. While a true for-profit ambulance enterprise should be calculating its pricing and cost strategies to generate a profit, that is simply not possible in many markets (American Society for Testing and Materials, International, 2008). The difference paid to a provider to make up for the gap in reimbursement is known as the *subsidy-price tradeoff* or *community tax support/ambulance fee tradeoff* formula (American Ambulance Association, 2008; Evans & Dyar, 2010). The tradeoff formula plots the total average patient bill on one axis and the subsidy per capita per year on the other. Variables for computing the

line include: system population, system costs, total transports, total unit hours provided, and the billing collection rate. The tradeoff allows system designers to measure the impact of subsidy or patient billing changes to determine whether the system can continue to operate at present levels. For public policy purposes, understanding the true subsidy price-tradeoff is critical for making system design decisions.

### **Performance Measure Trends and Operational Impact of System Changes**

Research in response times and demand management in recent years has led to innovative coverage techniques such as “system-status management” and computer simulation (Henderson, 2009; Goldberg, 2004). Indeed, response times have been the traditional method of measuring EMS system success and continue to play an important role in system design (National Association of State EMS Officials; National Association of EMS Physicians, 2009; David & Harrington, 2011; Wilde, 2012; McLay & Mayorga, 2010). Accreditation standards set by the Commission on Fire Accreditation International (CFAI), for instance, include measuring system performance at the 90<sup>th</sup> percentile. Response to emergency medical emergencies at the BLS and ALS levels are both included and are based on National Fire Protection Association standard 1710 and 1720. El Paso has adopted these recommendations and compares its own performance to these standards (El Paso Fire Department, 2012). Of course, evaluating system performance with the objective of improving the system requires a fundamental knowledge of how operations changes may affect the entire system.

Departments have a number of options for studying the impact of emergency response system changes. In the literature, two basic types of model emerge and both are designed to

address the response time/system cost issue. The first model, originally proposed in 1971, is known as the “set covering model”, which uses fixed locations for emergency responders and attempts to minimize the number of response units (locations) while maximizing coverage (Toregas, Swain, ReVelle, & Bergman, 1971). Another model, developed not long after the first, coined the “maximal covering model”, fixes the number of response units and then attempts to place them in way that covers expected demand as equitably as possible (Church & ReVelle, 1974). Each of these models has been expanded over the intervening 40 years to address their original limitations such as incorporating dynamic demand, including different shift schedules, addressing multiple time periods, including multiple (and sometimes competing) system objectives, consideration for back-up coverage and busy vehicles, identifying vehicle types and even reflecting the need for multiple response units (Goldberg, 2004). More recent research activity has begun to focus on real-time demand estimating and the deployment and redeployment of emergency vehicles, a problem fairly specific to the operation of an ambulance service. The solutions derived are more commonly known as “system status management” based on earlier recommendations from researchers and EMS practitioners (Boctor, Carpentier, & Ruiz, 2011; Stout, 1989). Nevertheless, despite the sophistication of more recent demand estimation modeling, accurate forecasts of emergency medical demand is a difficult proposition at best and resulting recommendations should be treated with a measure of caution (Setzler, Saydam, & Park, 2008).

Commercially available software now allow researchers and practitioners to test assumptions and system changes using today’s more advanced desktop computing power. These commercial systems incorporate features of the academic models previously mentioned.

For instance, Deccan International© publishes decision-support software for fire and EMS agencies known as the Fire/EMS apparatus deployment analysis module (ADAM™) and Hypercube ADAM™. As the name implies, the underlying academic model uses hypercube queuing (Larson, 1974). ADAM™, with its siting and optimization modules, is designed to use actual computer-aided dispatch (CAD) data to simulate the impact of system design changes (T. Gonzales, personal communication, November 29, 2012). The Optima Corporation© also produces software designed to assist emergency response planners deploy resources based on actual demand, travel time routes, etc. Optima predict™ is comparable to ADAM™ in using simulated responses to predict system impact of deployment changes (Optima Corporation, 2012). Motorola© also provides a software analysis package called MARVLIS™, which allows for both real-time and predictive analytics for emergency services providers (Motorola, Inc., 2008). ADAM™, Optima predict™ and MARVLIS™, as expected, go beyond their academic roots and incorporate proprietary algorithms, which are not open to analysis. Naturally, these are not the only decision support tools available for emergency medical services deployment, but are few of the more widely used. However, other than case studies and anecdotal evidence, little formal research has been undertaken by third parties to validate the results produced by these software packages.

### Procedures

The standard breakeven formula was used to predict the number of transports necessary for the current system to obtain an accounting profit of zero. In terms of emergency medical transports, the formula used was  $tr = fc / r^{\dagger} - vc$ , where;

$tr$  = total number of patient transports;

$fc$  = total system fixed cost;

$r$  = revenue per transport; and

$vc$  = variable cost per transport.

To determine transport system costs and ensure these costs are distinct from the department's other service costs, select parts of the fire-based EMS marginal cost template, specifically the staffing factor and marginal personnel requirements worksheets provided by the IAFF *EMS Guidebook*, were used (*International Association of Firefighters, 2009, pp. 66-84*). Data for the worksheets was taken from the department's human resources management software and the department's most recent standards of cover document.

The average leave used per employee was derived by sampling the first quarters for 2011 and 2012. Worksheet calculations are included in Appendix B. Accrued holiday and birthday leave hours were combined with vacation leave to derive total vacation leave taken per employee during each quarter analyzed. Training leave was excluded since almost all

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<sup>†</sup> *The number of transports and the revenue per transport figures were provided by the system's third party biller for calendar year 2011.*

uniformed employee training is conducted on duty and units are placed out of service for that purpose.

Staffing expenses were based on the current minimum staffing of 2 firefighters per ambulance plus allowance for expected leave (staffing factor of 3.4 per position). The current provision of 23 ambulances and 4 peak-time units was analyzed and also compared (for alternative deployment scenario purposes) to the system without those units. The differences in staffing are shown in detail in Appendix C.

Vehicle-related expenses were tabulated assuming that the present fleet continues to operate with existing trucks. Therefore, expenses tabulated for vehicles involved an analysis of Fiscal Year 2012 expenses for fuel and average maintenance costs per vehicle. It is recognized that these costs can vary from system to system based on the age of the vehicle fleet. In El Paso's case, most of the ambulances are 5+ years old, so maintenance is a little more expensive on an annual basis. Capital costs for the acquisition of new or remounted ambulances were not included.

### **Indirect Administrative Cost Calculations**

As with the direct costs, indirect costs were likewise taken from city budget documents, but expenses for liability insurance had to be estimated because the city liability insurance is self-funded. However, since the city requires third party local ambulance providers to obtain liability insurance of \$1,000,000.00, the premium estimate for that size policy was used. Administrative overhead expenses, which include legal, payroll processing, purchasing and general management, were estimated (pro-rated) based on the volume of emergency medical

response calls for the previous 3 years. Sixty-nine percent of the department's emergency responses involved calls to the emergency medical system (*El Paso Fire Department, 2012, p. 39*). These costs were added to the IAFF template since that template does not account for those indirect system expenses.

Response data for Fiscal Year 2012 was used to calculate the in-service utilization ratio. System costs were input into the price-subsidy trade-off model to derive an estimated local ad valorem subsidy; fee revenue was deducted from general fund expenditures and that figure was divided by the number Payer mix and reimbursement rates were provided by the department's third party biller for 2011 and 2012. Census estimates for 2012 were used for all population figures.

### **Base Fee Calculation**

Since the department presently uses a base fee calculation for present reimbursement billing, that same model was used to predict the required fee. A historic collection rate of 44 percent was assumed as well as a \$271.00 average amount collected per bill based on input from the department's third party billing firm. The mileage fee was left at its present rate of \$15/mile and was factored into average bill calculations based on a 6 mile average travel distance per transport. Vehicle depreciation was ignored in all calculations, but would certainly be a factor in a for-profit enterprise.

### **Operational Impact Assessment Procedure**

The final component of the research project involved estimating the potential impact on service levels if system design were altered. Three different scenarios were run. In the first

scenario, Deccan ADAM™ was used to estimate the impact of eliminating ambulance response altogether (*Deccan Intl, 2013*). Since the department uses ambulance staff to augment fire response, the scenario was split into two separate scenario analyses. In the first, ambulance staffing was simply eliminated. In the second analysis, ambulance staff was relocated to nearby fire units and the model was run again. Each analysis examined the potential impact on response times to fire, EMS, and all calls for service.

### Results

The first question this research attempted to answer is what are the present system costs including both fixed and variable cost calculations. EPFD transport system fixed costs are presented in Table 3. Total fixed costs for the present system amounted to \$16,982,245.72. The total includes all fixed costs for operating 23 full-time ambulances staffed by a total of 184 personnel (includes the staffing factor multiple) 365 days a year. Four peak-time units have also been included in the system fixed cost as per the current EPFD service level model.

Table 3

*Ambulance Service Fixed Costs*

<b>Fixed Transport System Costs<sup>‡</sup></b>	
Operations Personnel Salaries and Benefits	\$12,934,430.20
Support Personnel Salaries and Benefits	\$933,636.64
Vehicle Operating Costs	\$216,000.00
Training Costs	\$1,202,864.64

<sup>‡</sup> Facility expenses were not included under the present system since the units are collocated with fire units.

Legal Expenses	\$125,000.00
Liability Insurance	\$5,000.00
General Administrative Expenses	\$17,027.20
Communications Pro-rated Expense	\$1,518,287.04
Non-expendable Emergency Medical Equipment	\$30,000.00
<b>Total Fixed Costs</b>	<b>\$16,982,245.72</b>

Variable system costs are presented in Table 4. Variable costs have been annualized so that total system cost for a single year's operation can be calculated. Total annual variable costs in 2012 amounted to \$1,267,341.00. Consequently, total EPFD system cost to operate 23 ambulances and 4 peak-time ambulances in Fiscal Year 2012 was \$18,249,586.72.

Table 4

*Ambulance Service Variable Costs*

<b>Variable Transport System Costs</b>	
Expendable Medical Equipment	\$854,279.00
Fuel (average of 30,000 miles driven per ambulance and \$3.50/gal cost)	\$157,500.00
Billing expenses	\$255,562.00
<b>Total Variable Costs</b>	<b>\$1,267,341.00</b>

The second research question involved calculating the current price-subsidy tradeoff in El Paso. Adapting the industry prescribed formula for the price-subsidy tradeoff and accounting for present system revenue (excluding fee recapture from local private providers), the estimated local ad valorem subsidy per capita for the EPFD’s transport services is approximately \$9.50. Figure 4 depicts the price-subsidy tradeoff line under present system conditions. As indicated previously, the values on the y-axis indicate varying levels of collections per transport. This is not the same as the total billed per transport.

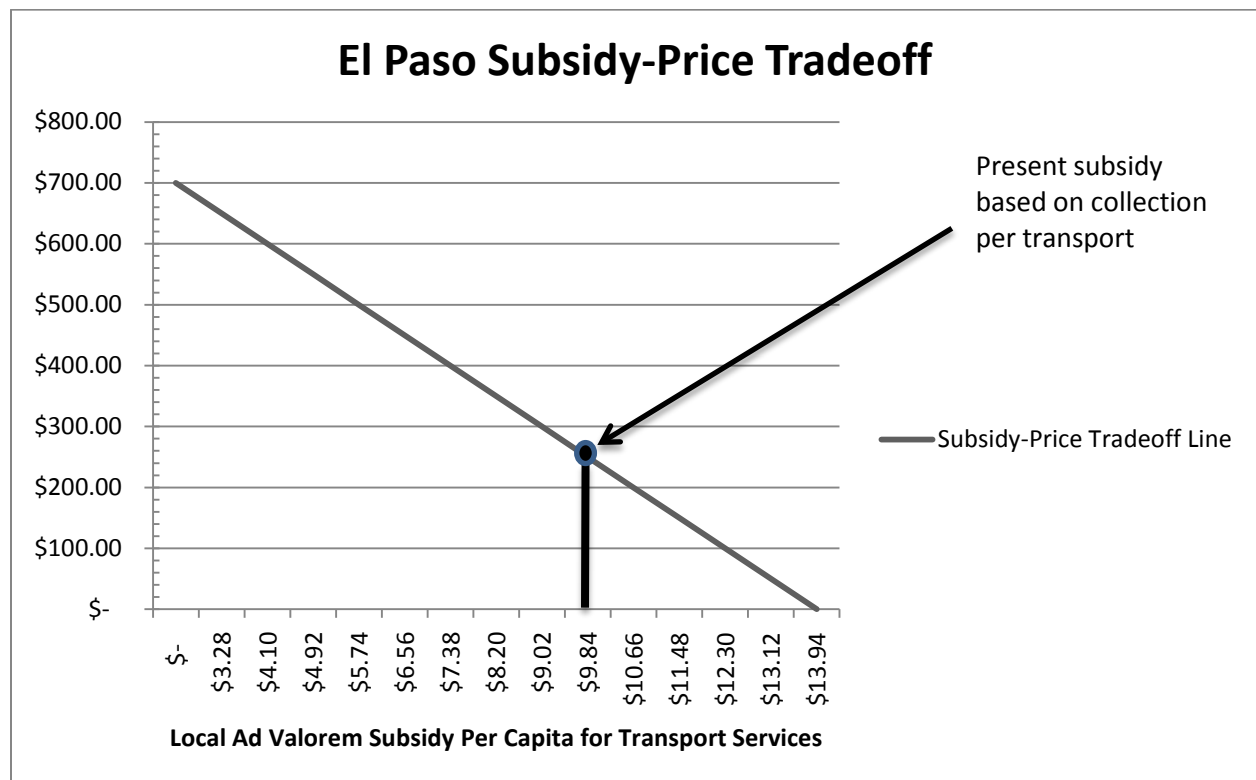


Figure 4. The price-subsidy tradeoff for El Paso under present system conditions. Collections per transport are a fraction of the total billed per transport.

The third research question involved setting an appropriate base rate given the costs currently borne by the fire-based EMS system. If all patients who were transported fully paid

for the department’s services, breakeven analysis depicted in Table 5 shows that the required number of transports would actually be less than that experienced by the system. That number is approximately 30,500, which is about 3,000 less than present demand. However, as stated previously, as is true with most systems, El Paso’s current collection rate is less than 50 percent; any base fee calculation must take that into consideration if the objective is complete cost recovery. Rearranging the standard breakeven analysis formula to calculate the required price at a 44 percent recovery rate, the base fee requirement becomes \$1,845.47, which is more than double the current rate of \$775.00 plus \$15/mile. It should be noted that the base fee projection includes an average mileage rate of 6 miles, so any mileage calculation above the recommended rate would be a duplicate charge.

Table 5

*Base Rate Fee Analysis*

<b>Breakeven Analysis<sup>5</sup></b>		
	<b>33,698</b>	Number of Transports
<b>\$</b>	<b>16,982,245.72</b>	Total Fixed System Cost
<b>\$</b>	<b>308.05</b>	Variable Cost Per Transport
	<b>30,492</b>	Breakeven # of Transports Necessary if All Patients Paid
<b>\$</b>	<b>1,845.47</b>	Charge necessary to recover costs at 44% collection rate

The last research question involved the potential operational impact of making system changes. Specifically, how would outsourcing ambulance transports affect other areas of service the department provides? One scenario examined the impact of no ambulances and no redistribution of existing personnel. In other words, eliminate ambulances and reduce the size

of the response force. In economic terms, this scenario would provide an approximate annual cost savings of approximately \$14,500,000.00. It is assumed that portions of the system's fixed costs would continue under all scenarios and a third party ambulance service would furnish all emergency medical equipment to the department. Table 6 shows the impact on fire and medical response times assuming the department provides only first responder services. Initial attack force time represents the arrival of at least four fighters on the scene to initiate fire attack. Medium and high risk fire incidents are differentiated in the standards of cover document by the number of personnel needed to assemble on the scene within 8 minutes or less (*El Paso Fire Department, 2012, p. 50*). For medium risk fires that number is 17 firefighters and for high risk fires the number is 25 firefighters.

Table 6

*Impact of Removing Ambulances from Response System*

<b>ADAM Performance Category (average times)</b>	<b>Current Deployment</b>	<b>Ambulances Removed from System</b>	<b>Difference from Current Deployment Scheme</b>
<i>First unit travel time (medical incidents)</i>	04:06	04:05	-0:01
<i>First unit travel time (fire incidents)</i>	03:49	03:49	0:00
<i>Initial attack force travel time (fire incidents)</i>	05:25	05:40	0:15
<i>Effective Response Force – medium risk travel time (fire)</i>	06:07	06:26	0:19

$$§ \text{ \# of transports needed} = \frac{\text{total fixed cost}}{\text{average patient bill} - \text{average transport cost}}$$

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<i>incidents)</i>			
<i>Effective Response</i>			
<i>Force – high risk</i>			
<i>travel time (fire</i>	11:58	12:59	1:01
<i>incidents)</i>			

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The operational impact of discontinuing transport services, but relocating existing personnel is shown in Table 7. Cost savings under this scenario would decrease to \$1,530,368.20 because essentially the same number of firefighters would be deployed even though there are fewer companies in the system. Curiously, ADAM™ indicates worse response times for the initial attack force even though 4 firefighters are already on the first-arriving fire unit. It also suggests an additional 1:36 is needed to assemble 17 firefighters for a medium risk fire, but indicates a substantial improvement in average response time for high risk fires (3:13 seconds).

Table 7

*Impact of Removing Ambulances but Redeploying Personnel*


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<b>ADAM Performance Category (average times)</b>	<b>Current Deployment</b>	<b>Ambulances Removed from System and 4-person companies</b>	<b>Difference from Current Deployment Scheme</b>
<i>First unit travel time (medical incidents)</i>	04:06	04:07	0:01
<i>First unit travel time (fire incidents)</i>	03:49	03:49	0:00
<i>Initial attack force travel time (fire incidents)</i>	05:25	05:55	0:30
<i>Effective Response Force – medium risk</i>	06:07	07:43	1:36

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*travel time (fire incidents)*

*Effective Response*

*Force – high risk*

*travel time (fire incidents)*

11:58

08:45

-3:13

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### Discussion

From the results of this research, two things become abundantly clear about El Paso's current situation; as is true with most systems, the provision of pre-hospital emergency care is very expensive at current service levels and the current payment system is inadequate to avoid continued local government subsidies. El Paso's fire-based EMS system shows response times well within nationally acceptable standards for all hazards. Changing the system to eliminate ambulance service would be harmful to current service levels. In fact, in order to approach the service levels as they stand today, it would be necessary to stand up additional firefighting units as well as add more personnel per fire apparatus. Savings would likely be negligible since most of the cost of providing emergency response is associated with salaries.

The research also suggests that maintaining the service in its current form means accepting that taxpayer subsidy is necessary. To avoid subsidizing transport, substantial increases in transport charges are necessary to recover costs, but doing so will not guarantee an elimination of the subsidy. Most of the additional charges would fall disproportionately on private insurance since Medicare and Medicaid pay a fixed rate regardless of cost. It is also unlikely that private insurance will absorb these additional charges indefinitely. Moreover, the

recommended base charge of over \$1,800.00 per transport far exceeds the norm charged elsewhere in Texas, so there will be little political support for this type of policy recommendation.

This situation begs a number of policy questions worthy of further research and consideration. Foremost among these is whether or not the fire department should continue to provide transport services or allow a third party to do so. Expenses are high, largely due to personnel salaries and benefits as one would expect. This is not to say that the EPFD could not look for innovative ways to reduce system cost such as triaging emergency medical calls before dispatch using highly trained medical personnel as at least one system has done (Commission on Accreditation of Ambulance Services, 2009). Other opportunities for cost savings are possible as well. These options were simply not studied as part of this research.

Nevertheless, industry experts would suggest that a private service could provide similar levels of response at reduced cost, thus obviating the need to raise transport charges as substantially as proposed herein. However, reduced costs would clearly be associated with lower pay and benefits for employees, which the IAFF contends is problematic for employee retention. Employee turnover is touted by the IAFC and IAFF as an important EMS system measure because it is argued poor benefits leads to unhappy employees and ultimately, poor patient outcomes (International Association of Firefighters, 1999). However, little research has been undertaken to endorse these assertions and, consequently, no general consensus exists for including turnover as a national system measure (National Association of State EMS Officials; National Association of EMS Physicians, 2009; National Fire Protection Association, 2013;

Balaker & Summers, 2003). Pay and benefits for employees will likely be a hotly contested issue for many years to come between public and private sector interests, especially in light of more recent research suggesting that public sector full-time employment falls with increased privatization (Fernandez, Smith, & Wenger, 2006).

### **Operational Impact**

In terms of the initial attack force (IAF) and effective response force (ERF) times, ADAM™ consistently predicted greater travel times with fewer ambulances in the system. This stands to reason since ambulances are presently used in the EPFD as 2-firefighter response units. Likewise, even with fewer units but more firefighters per unit, system travel times for ERF improve, so a shift to fewer ambulances with the same on-duty staffing has a smaller operational impact on the system. Nevertheless, travel times still degrade from the current deployment model.

### **Initial Attack Force Results**

Despite the foregoing, the operational results from this research raise a very important question with regard to the forecasting model itself. Specifically, it suggests that 4-person companies are not as quick to arrive with an IAF than 3-person companies. The counterintuitive nature of this prediction suggests the model may be inaccurate for all travel times, but the problem is more related to how the model samples its data rather than how the model is constructed.

With regard to the IAF travel time, the EPFD uses it to determine how quickly the first arriving unit(s) can initiate fire attack. In many other departments the IAF is achieved with the first unit on the scene because it arrives with 4 or more firefighters. In the analysis for this research, ADAM™ implied that the IAF response times with 4-person companies and no ambulances would be 15 seconds slower than the same system with 3-person companies. A closer look at how the ADAM™ model samples historical data showed that the switch in staffing increased the pool of incidents surveyed. With 4 firefighters, there was a larger subset of incidents from which the IAF could be calculated. The larger pool changed the average response time values and negatively impacted results. Consequently, the IAF results for the 4-person companies and no ambulances scenario cannot be relied upon with certainty.

### **Customer Service Outcomes**

Despite the previous discussion regarding costs, no debate over the provision of pre-hospital emergency care should ignore the impact on service levels and patient outcomes. For instance, more recent research has led to a broadening of what experts consider appropriate system measurement and success (Wilde, 2012; National EMS Advisory Council, 2012). Focus is increasingly placed on the impact on patient outcomes and customer service rather than just on financial viability and efficiency (Committee on the Future of Emergency Care in the United States Health System, 2007). However, the paucity of data available associated with new outcome-based performance measures makes measurement difficult at the present time. Consequently, response time, time to patient contact, and time to hospital arrival are still the clearest way to measure system performance and compare providers.

El Paso predominantly uses response time for EMS service level objectives and that was used to analyze potential system impact of any deployment changes. As with most systems, it is simply assumed that faster response times mean better patient outcomes. However, it is quite possible to arrive quickly and be completely ineffective (Wankhade, 2011).

### **The Cost of BLS Service**

It is clear from the results of this research, however, that service levels for all types of emergencies would degrade substantially if the department's ambulances were decommissioned and substitute companies were not provided for initial response coverage. Providing substitute coverage to maintain service levels, nonetheless, would almost eliminate any potential savings from outsourcing transport services unless the department charged a substantial "readiness" fee for its first responder service. That fee, though, would no doubt be disputed by private ambulance services since some contend that fire departments are supposed to respond to all emergencies regardless of type (Poole Jr., 1995). In essence, though, by not charging a fee, the taxpayer subsidizes the cost for providing fast response times. If an adequate fee were assessed for first responder services, outsourcing transport service would be feasible and the taxpayer would not be burdened unfairly with the cost of keeping response times low for medical emergencies (Blackstone, Buck, & Hakim, 2007). The determination of that fee was beyond the scope of this research project.

However, it is not enough to simply outsource transport services if the ultimate objective of the fire department were simply to avoid the expenses associated with ambulance service. Transaction costs associated with outsourcing must be considered along with a

consideration for consequences of failure if the private service could not achieve its service levels or maintain sustainable operations (Brown & Potoski, 2005). Indeed, if outsourced transport services in the future were suddenly discontinued, the department would bear considerable cost to maintain those services. This research did not consider the potential economic and service level impact that situation might pose for the department.

### **Recommendations**

Pre-hospital emergency care has become an important part of a community's feelings of well-being and safety. In El Paso, the fire department provision of emergency medical service is the community's primary concern and satisfaction with the existing service is high (El Paso Fire Department, 2012). As has been demonstrated, though, the expense associated with providing local ambulance service is substantial and revenue collection is comparatively low. Though the department recaptures part of its cost for providing ambulance service, it presently operates at a net deficit. As costs rise and the pressure to raise rates along with them each budget cycle, the debate over public versus private provision of ambulance service is likely to heat up as well. Informed citizens may not agree with the present transport subsidy arrangement and push for change (Moody, 2009).

For local public policy officials, therefore, the decision to outsource transport services should begin with a declaration of what constitutes acceptable levels of service for fire and EMS responses. If the EPFD's standards of cover are used, this would mean beginning with the stated service level objectives previously described. These service levels then become the

backbone of system design prospectively. In El Paso, that is already being done, so the true debate over transport services should center on the fee for first responder services. No private ambulance provider should be allowed to “cherry pick” the revenue generating piece of pre-hospital emergency care without adequately compensating the taxpayer (International Association of Firefighters, 1999; Blackstone, Buck, & Hakim, 2007). If the fee is too exorbitant for private ambulance services to maintain sustainability then the EPFD should be encouraged to continue providing BLS/ALS services. If the decision is to outsource transport services, the city and the department should be careful to count the true transaction costs, which include accounting for the impact of change on department employees, and ensuring the implementation strategy and the reasons for doing so are truly sound (Carroll & Mui, 2008; Kotter, 2012).

The department should explore further ways to reduce cost and maximize the use of existing resources. Creative EMS deployment and delivery, and cost recovery methods should continue to be explored and pilot-tested, where possible (Stout, Pepe, & Mosesso Jr., 1999; United States Fire Administration, 2012; Blackstone, Buck, & Hakim, 2007). The department should also embrace the current movement toward patient-centered outcomes since future revenue will likely be tied to these. Performance measures should include time to patient contact rather than just total response time as it is recorded today and false alarm calls should be eliminated from the system as much as possible. Additionally, groundwork should be laid to increase ambulance transport revenue even if base rate hikes fall disproportionately on private insurance. Though little can be done locally about Medicare and Medicaid reimbursement rates, the department should participate in national debate regarding cost recovery.

Regardless of what type of agency provides ambulance transport services, cost for pre-hospital emergency care is falling more and more on the local taxpayer and the department should take a more active role in educating the local public. It is unlikely that taxpayers at the local level in most communities including El Paso truly understand this issue and the burden they currently bear.

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**Appendix A: Transport Fee Comparisons***Table A - 1*

<b>Agency</b>	<b>ALS1/ALS2</b>	<b>Specialty Care Transport</b>	<b>BLS</b>	<b>Mileage</b>	<b>Treatment No Transport</b>	<b>Supplies</b>	<b>Oxygen</b>
<b>City of Dallas</b>	\$965/\$1,040	None	\$897	\$15	\$164	Itemized	\$45
<b>Houston FD</b>	\$1,000/\$1,000	None	\$1,000	None	None	No add'l charge	\$80
<b>City of Bowie</b>	\$1,523/\$2,003	None	\$1,239	\$15	\$175	Itemized	\$119
<b>City of Mexia</b>	\$1,514/\$1,839	None	\$1,201	\$15	None	Itemized	\$119
<b>Waller County</b>	\$2,718/\$3,071	None	\$1,829	\$21	\$211	Itemized	\$135
<b>Pecos County</b>	\$2,036/\$2,605	None	\$1,549	\$15	\$175	Itemized	\$119
<b>Eagle Pass FD</b>	\$400/\$400	None	\$400	\$7	\$50	Itemized	\$30
<b>El Paso FD</b>	\$670/\$670	\$850	\$670	\$11	\$143	No add'l charge	None

**Appendix B: Staffing Factor Worksheet**

Table B - 1

<b>Hours of work to be covered in 1 year</b>	
Days of work	365
Hours of work	24
Total annual hours of work	8760
Number of shifts/positions	3
Hours worked per group	2920 (8760 divided by # of shifts)
Work week (hours)	56
<b>Average leave used per employee (hours)</b>	
Average sick leave	62
Average on-duty-injury leave	34
Average vacation leave	215
Average training leave	0
Average holiday leave	0
Average bereavement leave	0
Average other leave	18
Total average leave per employee	329
<b>Hours actually worked by average employee</b>	
<b>Staffing factor calculation</b>	
Total annual hours of work	8760
Hours actually worked by average employee	2591
STAFFING FACTOR	3.4 (The number of employees required to fill one position 24/7 within the department)

**Appendix C: Marginal Personnel Requirement Calculations**

Table C - 1

*Marginal Personnel Requirements for a System with and Without Ambulances*

**Marginal Personnel Requirements Worksheet - Current**

<b>Type of apparatus</b>	<b># of apparatus</b>	<b>Minimum staffing</b>	<b>Staffing factor</b>	<b>Total personnel required</b>
Engine	38	3	3.4	386
Engine	3	2	3.4	21
Ladder	5	3	3.4	51
Rescue	0	2	3.4	0
Peak Time Rescue	0	2	3.4	0
Chief's car	6	2	3.4	41
Shift commander	1	1	3.4	4
Other	2	3	3.4	21
Required Personnel Per Shift				175
Current Total				524

**Marginal Personnel Requirements Worksheet - Proposed**

<b>Type of apparatus</b>	<b># of apparatus</b>	<b>Minimum staffing</b>	<b>Staffing factor</b>	<b>Total personnel required</b>
Engine	38	3	3.4	386
Engine	3	2	3.4	21
Ladder	5	3	3.4	51
Rescue	23	2	3.4	156
Peak Time Rescue	4	2	3.4	28
Chief's car	6	2	3.4	41
Shift commander	1	1	3.4	4
Other	2	3	3.4	21
Proposed Personnel Per Shift				236
Proposed Personnel Total				708
Marginal personnel difference between current and proposed				207.36

**Appendix D: Additional System Measures**

Table D - 1

*U:UH and Unit Utilization Measures for a 1-year Cycle*

Unit-Hour Utilization	
47,124	Total Number of Patient Encounters in Cycle
236,520	Total Number of Unit Hours of Coverage Provided During Cycle
0.20	Unit-Hour Utilization Figure
Unit Utilization	
	Total Number of Patient Encounters * Average Expected Call
3,063,060	Time
14,191,200	Total Number of Unit Hours of Coverage Provided Curing Cycle
0.215842212	Unit Utilization